Summary & Outlook

Platinum

- Demand for platinum in 2000 is forecast to rise by 2 per cent to reach a new record level of 5.69 million oz.
- Jewellery demand will increase for the 17th consecutive year to reach a new high of 2.94 million oz, although the expected 2 per cent increase is smaller than in recent years, due to higher prices.
- After three years of modest decline, platinum demand for autocatalysts is expected to increase by 12 per cent to 1.8 million oz, due mainly to greater use on diesel cars in Europe.
- Industrial demand should rise by 8 per cent, with continuing growth in the use of platinum in computer hard disks and the production of glass for liquid crystal displays.
- Supplies of platinum are forecast to increase by 11 per cent to 5.41 million oz, with substantially higher shipments from Russia following amendments to the legislation that inhibited exports in 1999.
- With demand expected to exceed supplies by 280,000 oz, the price of platinum has advanced strongly this year, rising from a low of $414 in January to a high of $612 in August.

Platinum Supply and Demand
'000 oz

	1999	2000
Supply		
South Africa	3,900	3,920
Russia	540	1,100
North America	270	285
Others	160	105
Total Supply	**4,870**	**5,410**
Demand		
Autocatalyst: gross	1,610	1,800
recovery	(425)	(460)
Jewellery	2,880	2,940
Industrial	1,355	1,460
Investment	180	(50)
Total Demand	**5,600**	**5,690**
Movements in Stocks	(730)	(280)

Overview

Demand for platinum in 2000 is forecast to rise by 90,000 oz to its highest ever level of 5.69 million oz, propelled by a 190,000 oz increase in purchases by the auto industry. This advance is due mainly to higher loadings on catalysts for diesel cars, which have gained market share in Europe. In addition, there has been the beginning of a return to the use of platinum in autocatalysts for gasoline cars, a move that is expected to gain momentum in future years, especially if the palladium price remains above that of platinum.

The use of platinum in jewellery has continued to grow, despite the increased price of the metal. The exception has been in Japan, where demand at the cheaper end of the market has proved to be price sensitive. Remarkably, the Chinese jewellery market, where higher prices were expected to have most impact, has grown again and will exceed 1 million oz for the first time.

The most significant impact of the higher price this year has been a sharp decline in purchases of platinum for investment. Demand for coins and small bars is expected to halve, and Japanese investors have taken advantage of higher yen prices to take profits on large investment bars bought in earlier years.

Industrial demand is expected to grow by 105,000 oz. Increased use of platinum in computer hard disks will boost electrical demand by 90,000 oz. Investments in new plant to make high quality glass for liquid crystal displays used in consumer electronic goods will contribute to an increase of 40,000 oz in the glass industry. Demand in the chemical and petroleum refining sectors will decline marginally.

Supplies have also expanded, by 540,000 oz to 5.41 million oz. The largest contributor to the increase has been Russia, where the restrictions on exports of platinum imposed by the notorious Clause 19 of the 1999 Russian budget legislation were lifted by an amendment to the law signed early in January 2000.

We forecast a deficit of platinum again this year, although the shortfall between supply and demand of 280,000 oz will not be as high as the record level of 1999.

The price of platinum made strong gains throughout the first nine months of the year. After falling to a low of $414 early in January, following news of the amendment to Clause 19, it rose sharply thereafter as Russian sales fell below expectations. Physical shortages of metal drove lease rates above 70 per cent in January and again in April. Although Russian deliveries increased from May, strong consumer demand supported the price, which reached $612 in August and again in September, the highest level since December 1988.

Supply

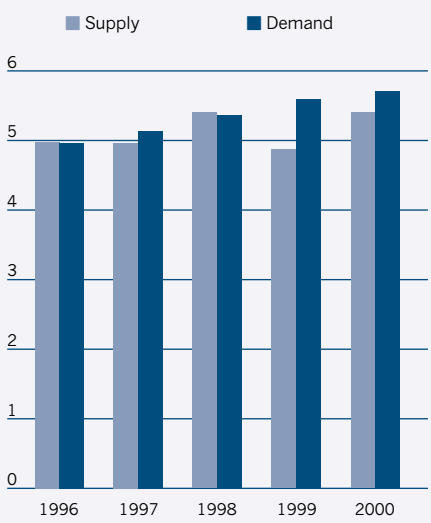
Supplies of platinum from South Africa in 2000 are expected to be only 20,000 oz higher than last year, a much smaller increase than originally expected. Severe rains between February and April led to flooding of some mines and also affected surface processing operations, while strikes have also contributed to shortfalls in production. Despite this, the current year has been one of excitement and optimism in the South African industry. In response to higher prices and prospects of sustained growth in demand for platinum, all the South African producers have embarked upon expansions of their mining operations. In addition, several companies new to platinum mining have appeared on the scene.

The largest producer, Anglo Platinum (formerly Amplats), already has expansion projects at Amandelbult, Lebowa and Bafokeng-Rasimone that are nearing completion, and in December 1999 announced the construction of a new mine at Maandagshoek. In May this year, Anglo announced its intention to expand platinum production even further, to around 3.5 million oz by the end of 2006. Full details of this extra expansion were not revealed, but new projects at Kroondal and Waterval have subsequently been confirmed.

The other platinum producers in South Africa have also been active. Impala, as an 85 per cent owner, is participating in the reopening of the Crocodile River mine, which should deliver its first metal in 2001. In June, it was announced that Impala is to acquire the Toronto-based Platexco and develop a new mine on that company's Winnaarshoek property in the Eastern Bushveld. The third largest producer, Lonmin, announced, also in June, plans to raise output at its existing operations to 800,000 oz by 2007.

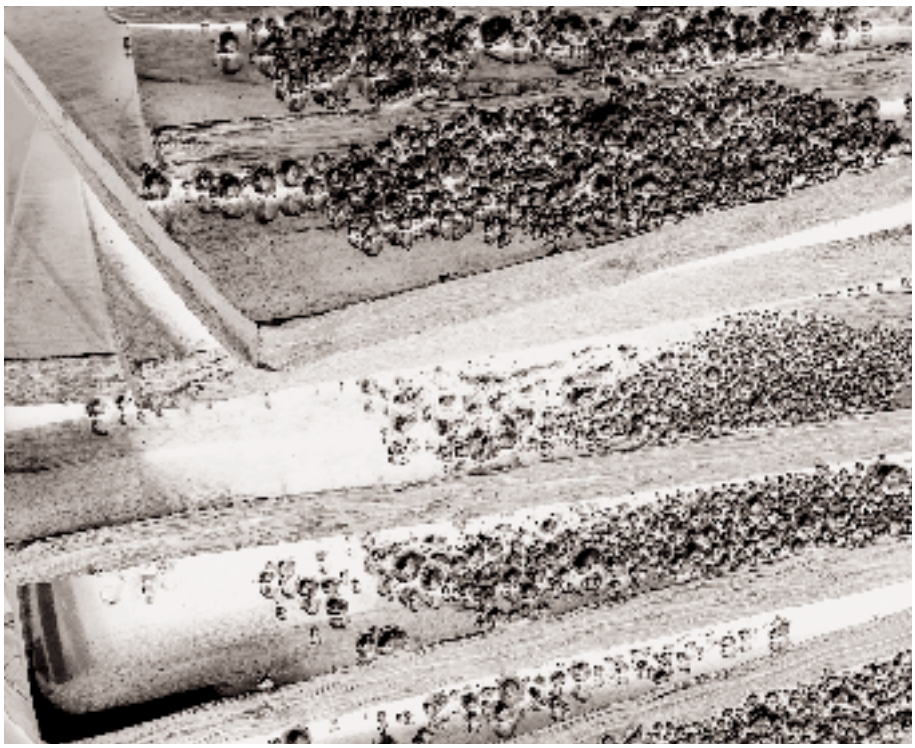
Supply and Demand for Platinum 1996-2000

Million oz



Northam and Kroondal were new entrants to the platinum market in the 1990s. Northam produced its first metal in 1993, but has struggled to make money. However, at current production rates and pgm prices Northam is profitable and plans to increase output from 2001 through an expansion of mining on the UG2 reef. Kroondal only commenced mining in 1999 but a joint venture agreement with Anglo Platinum, announced in August, should enable it to triple platinum output.

Aquarius Platinum, a 45 per cent owner of Kroondal, is also progressing a number of other pgm prospects, some of which were acquired from Impala in July this year. The most advanced is at Marikana, which should yield its first pgm in 2001. Another new entrant is the Canadian miner SouthernEra Resources, which has acquired Impala's majority



interest in the Messina project. This mine was partly developed in the early 1990s before being mothballed when pgm prices were weak. Work is underway to restore and extend the mining infrastructure and full scale production of platinum is scheduled for 2003.

Figures for platinum production in Russia are still a state secret, but it seems likely that output at Norilsk has increased. Driven in part by the high price of pgm, Norilsk Nickel is investing substantially in improving mining infrastructure and process efficiencies, and is giving greater attention to maximising recovery of pgm. However, Russian pgm supplies do not necessarily move in line with production changes. As an example, for much of 1999 Norilsk was unable to sell its platinum and rhodium output due to the restrictions set by Clause 19 of the 1999 Russian Budget legislation. Although an amendment to this legislation was signed by President Putin early in January 2000, it was not until May that export quotas and licences were approved and significant amounts of platinum began to flow from Russia to western markets.

Norilsk has been cushioned by revenues from palladium, sales of which were not restricted by Clause 19. The alluvial producers in the Far East of Russia have been less fortunate: they produce only platinum and had no choice in 1999 but to sell, probably at discounted prices, in the home market. The consequent lack of revenue has hindered placer mining during the 2000 season and annual output is thought to have fallen to two thirds of peak levels, at around 200,000 oz. Total Russian sales in 2000 are nonetheless expected to increase by 560,000 oz to 1.1 million oz.

Other western supplies have declined in 2000, primarily due to the closing of the Hartley Platinum mine in Zimbabwe in June 1999. North American output has increased slightly, with higher production at Inco and North American Palladium outweighing a decline at Falconbridge caused by a prolonged strike at its Sudbury nickel mines. Output at Stillwater will be similar to that of last year.

Demand

Demand for platinum has grown in most sectors – the principal exception being the market for investment products, which this year has seen a sharp decline in sales of coins and small investment bars and a net sellback of large investment bars in Japan.

Jewellery demand for platinum has continued to grow, but at a less rapid pace than in recent years. Higher platinum prices have had some effect in curtailing demand for platinum in the lower value jewellery sector. But in China, where retail prices and margins are lower than in most other manufacturing countries, demand has increased by 15 per cent and this year will exceed 1 million oz for the first time. Advances have also been seen in Europe, principally the UK, and in the USA.

In contrast, Japan, although still the largest jewellery market for platinum, is expected to experience a decline of 13 per cent in demand this year. Despite signs of recovery in the Japanese economy, private consumption still lags other economic indicators and demand for platinum jewellery at the cheaper end of the market has proved sensitive to the higher metal prices, with some share being lost to lightweight white gold products. However, sales of more expensive platinum jewellery were slightly up in the first half of 2000, evidence of platinum's strong position in this sector of the market.

The use of platinum in autocatalysts has recovered this year and the prospects are for higher demand in the future. The reversal is largely due to higher loadings on catalysts fitted to diesel engines in Europe to meet the Euro III legislation that came into force in January 2000. The impact of this change has been enhanced by a 13 per cent increase in sales of diesel cars in Europe as consumers opt for more fuel efficient vehicles to counteract higher fuel prices. There has also been some switching from palladium to platinum in catalysts for gasoline vehicles as auto makers seek to reduce their dependence on palladium. Better technology is leading to platinum-containing catalysts of equivalent performance to those based

mainly on palladium, capable of meeting existing and future standards. Looking ahead, the use of platinum seems likely to increase significantly for gasoline vehicles, as manufacturers, perceiving South Africa to be a more predictable source of pgm than Russia, seek to reduce their dependence on palladium.

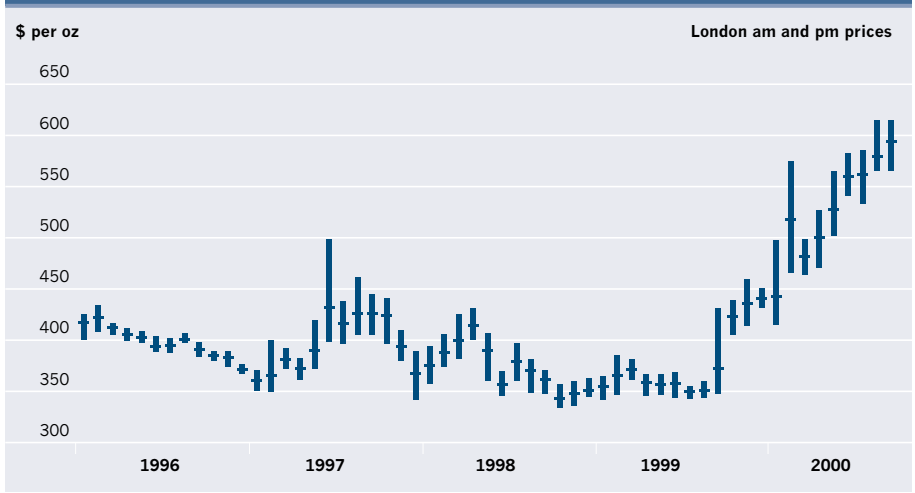
Industrial demand for platinum is expected to rise by 105,000 oz, led by increases in the electrical and glass industries. The use of platinum in hard disks for computer storage has grown and this year we believe that more than 90 per cent of all computer hard disks will contain platinum to improve data storage capacity, up from around 75 per cent in 1999. This will be the major contributor to an increase of 90,000 oz in demand from the electrical sector.

The market for the high quality glass necessary for liquid crystal displays (LCDs) is buoyant, with rapidly increasing use of LCDs in consumer electronic goods such as computers, digital cameras and televisions. As a result, most leading manufacturers of LCD glass are currently adding to their production capacities.

The market for investment products has been adversely affected by the rising price of platinum this year. Investors in Japan traditionally buy precious metals when prices are perceived to be low, or at times of significant price falls. In the period 1993 to 1996, and again at times in 1998 and 1999, they bought substantial amounts of platinum in the form of 1kg and 500g investment bars at prices below ¥1,400/g. The rise of platinum to a level of over ¥2,000/g this year has encouraged some investors in Japan to take profits. As a result, we expect net demand for large bars in Japan to be negative in 2000.

Purchases of platinum coins and small bars have also fallen this year. Sales of the US Mint's platinum bullion coin in the American Eagle series have declined sharply, and few Australian Koalas and Canadian Maple Leafs have been minted. However, we expect most, if not all, of this year's edition of the proof mintage of the platinum Eagle to be sold, even though it was not available for sale until September. There is evidence that some coins and small bars have been sold back by US investors taking advantage of the higher platinum prices, and we believe that some of these products have subsequently been melted and recycled as jewellery alloys. Overall, we expect that net offtake in 2000 for coins and small bars worldwide will halve to 45,000 oz.

Monthly High, Low and Average Prices of Platinum
January 1996 - September 2000



Outlook

With demand for platinum forecast to exceed supply by 280,000 oz, following on from a record deficit of 730,000 oz in 1999, the market for platinum remains tight and extremely sensitive to changes in both supply and demand. As in several years past, there is still uncertainty about how much metal Russia will export in the remainder of the year, and how quickly export quotas and licences will be granted in the new year. Other supplies should grow, with increasing contributions from expansions in South Africa in 2001.

Two factors are likely to have most influence on demand for platinum in the near future. Higher prices of platinum have had only a limited negative effect on jewellery consumption. Despite this, there are concerns that demand could prove to be price sensitive, especially in China, where the margins between retail prices and material costs are slimmest. Manufacturers may be reluctant to buy platinum should the price rise much above the $600 level, although there is no sign at present of any waning of desire on behalf of Chinese consumers to acquire platinum jewellery.

Demand for platinum in autocatalyst has recovered some of the ground lost in recent years, and the outlook is for continued growth, both for diesels and as an alternative to palladium in some catalysts fitted to gasoline vehicles. Although the impact of any switch from palladium is likely to be gradual in the immediate future, a few companies have increased their inventories of platinum in 2000, in anticipation of increased demand. If other auto makers follow suit this could boost near term demand for platinum.

On balance, we believe that platinum will trade in a range of $560 to $630 over the next six months.

Palladium

- After 14 years of continuous growth, demand for palladium is forecast to decline by 10 per cent to 8.40 million oz in 2000.
- Purchases of palladium by the auto industry are set to fall by 12 per cent, as some auto companies draw heavily on stocks.
- Demand for palladium in electronics is expected to rise by 5 per cent as increased substitution by base metals is outweighed by the growth in capacitor production.
- The use of palladium in dental alloys has fallen by 22 per cent due to the higher price; demand in other applications is down 9 per cent.
- Total supplies of palladium in 2000 are forecast to decline by 2 per cent to 7.92 million oz.
- Norilsk Nickel has continued to ship palladium steadily, but overall supplies from Russia are expected to fall by 4 per cent to 5.2 million oz due to lower sales from government stocks.
- We expect demand to exceed supply by 480,000 oz, which, combined with last year's even larger deficit and continuing uncertainties about Russian supplies has driven the palladium price to record highs.

Palladium Supply and Demand
'000 oz

	1999	2000
Supply		
South Africa	1,870	1,960
Russia	5,400	5,200
North America	630	665
Others	160	95
Total Supply	**8,060**	**7,920**
Demand		
Autocatalyst: gross	5,880	5,160
recovery	(195)	(230)
Dental	1,110	870
Electronics	1,980	2,070
Other	585	530
Total Demand	**9,360**	**8,400**
Movements in Stocks	(1,300)	(480)

Overview

Total demand for palladium is forecast to fall by 960,000 oz in 2000. The main reason for this decline, the first for 14 years, is a lower level of purchasing by the auto industry. In contrast with the last two years, when inventories of palladium were added to substantially, this year several major auto makers have drawn down their stocks, to mitigate the impact of dramatically higher prices.

Supplies in 2000 are also down, by 140,000 oz to 7.92 million oz. The net impact is that demand will again exceed supply, though by a smaller amount than in 1999. The resulting deficit of 480,000 oz will be met, in part, by sales from the US Defense Stockpile. In the first nine months of 2000 the Defense Logistics Agency (DLA) sold 64,000 oz of palladium and is authorised to sell a further 300,000 oz in the fiscal year commencing October 2000.

Having started the year at around $440, a lack of Russian supplies drove the price of palladium upwards in the first two months and precipitated an intense squeeze on TOCOM as investors scrambled to close out short positions. The price peaked at $800 on 21 February before the TOCOM authorities imposed restrictions on trading. After declining to $553 by April, the price then rose steadily from June to reach a new high of $855 in August, before declining to $712 in September as the first contractual metal of the year arrived in Japan from Russia.

Supply

The supply of palladium from Russia has once again been a major factor in the volatility of the price this year. Norilsk Nickel claims to be supplying steadily from production, but its willingness to enter into long term contracts with consumers has almost certainly resulted in less metal being available for spot sales by Almaz than in previous years. In addition, and perhaps more importantly, it appears that the Central Bank - a major contributor to Russian supplies in recent years - has been less active as a seller of palladium in 2000.

Rumours persist that the Central Bank has entered into collateral deals with western banks and it may be that these arrangements have reduced the amount of palladium currently available for sale. There are also indications that part of the stock previously held by the Central Bank has been returned to the Ministry of Finance; it is not clear how much of this metal will be sold this year. Despite these uncertainties, we believe that Russian exports in 2000 will total 5.2 million oz, just short of last year's level.

Supplies from western mines are expected to increase by 60,000 oz in 2000 to 2.72 million oz, mainly due to an increase in sales by South African mines

of 90,000 oz. North American output will be up 35,000 oz, with higher output from Inco and North American Palladium partly offset by lower production at Falconbridge. The closure of Hartley Platinum in Zimbabwe in 1999 has sharply reduced the amount of palladium from other sources.

Demand

Demand for palladium is forecast to fall by 10 per cent to 8.4 million oz. This, the first decline in demand for 14 years, follows a period of strong growth over the previous five years, when demand almost doubled.

The main reason for the decline is that demand from the auto industry has fallen by 720,000 oz in 2000 to 5.16 million oz. In sharp contrast with recent years, when auto companies added to inventories, we believe some have drawn down stocks in 2000 to mitigate the effect of the higher prices ruling for palladium this year. The fall in demand is misleading, however, as the use of palladium in autocatalysts fitted to new cars has risen. Increased consumption has occurred principally in Europe and the USA as companies have produced a higher proportion of low emission vehicles to meet new standards in these regions.

Companies manufacturing multi-layer ceramic capacitors (MLCC) have continued to advance the substitution of palladium, mainly with nickel. However, a massive 50 per cent increase in the number of MLCC produced this year has resulted in a small increase in demand for palladium in this application. Despite further substitution in other electronics applications, we estimate that overall demand for palladium by the electronics industry will increase by 90,000 oz this year to reach 2.07 million oz.

Consumption of palladium in dental alloys will fall again this year, by 22 per cent to 870,000 oz, in response to the higher metal prices. Demand in Europe and North America has fallen by more than a third, but the use of palladium in Japan has been less affected. In April, the Japanese government changed the system of payments under the state insurance scheme for dental treatment using the standard gold:palladium alloy. The new arrangement will reflect more closely the actual cost of materials used and should thereby reduce sensitivity to changes in metal prices.

Outlook

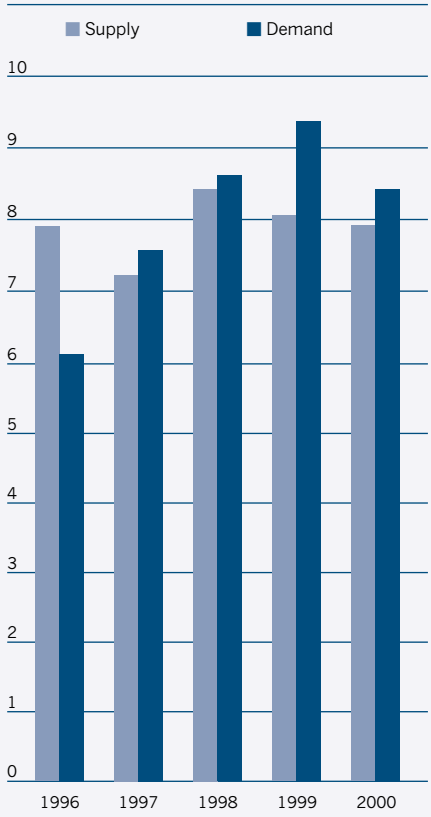
The future outlook for palladium demand is heavily dependent on the degree to which substitution of the metal is achieved in its main applications, and the rate at which any such changes occur. There has already been significant substitution of palladium in electronics applications and in dental alloys and more can be expected.

During 2000, several auto makers have expressed their intention to reduce palladium usage by thrifting catalyst loadings or substituting with other pgm. Although such moves will impact future demand, stricter emissions standards worldwide, especially for hydrocarbons, seem certain to ensure that palladium will continue to play a major role in the control of auto emissions.

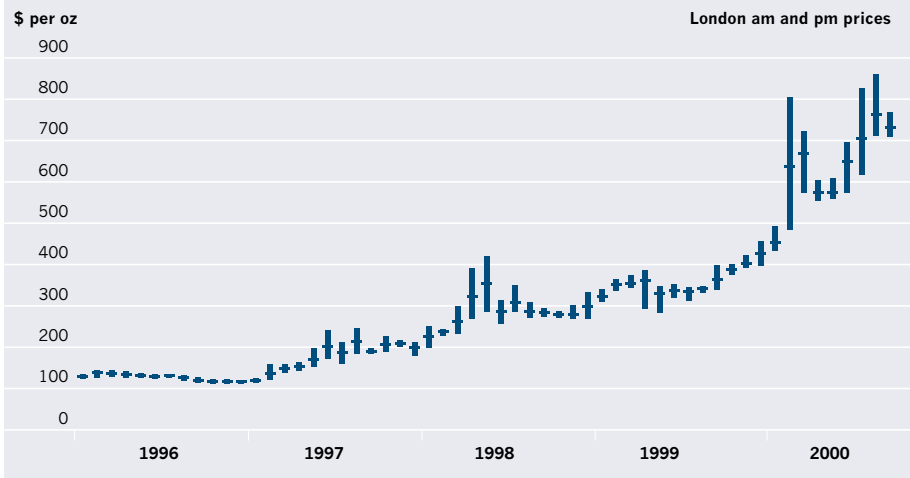
With demand for palladium continuing to exceed mine production, the level and pattern of Russian sales from stocks will again be the critical factor in determining the price of the metal. For the next six months we expect a range of $700 to $850.

Supply and Demand for Palladium 1996-2000

Million oz



Monthly High, Low and Average Prices of Palladium January 1996 - September 2000



Supplies, Mining and Exploration

South Africa

Platinum supplies from South Africa are forecast to reach 3.92 million oz in 2000, an increase of just 20,000 oz. Palladium shipments are expected to total 1.96 million oz, while those of rhodium will reach 434,000 oz.

Several of the South African platinum mines suffered from interruptions to mining and milling during a period of heavy rainfall early this year and, as a result, refined pgm output during the first half was lower than expected. Despite the build-up of production at several new operations, we forecast that platinum supplies will be only slightly higher than last year, at 3.92 million oz.

South African supplies are predicted to rise sharply in 2001. All the existing producers have expansion projects, several of which will come on-stream next year. Beyond 2001, major new mines are to be developed at Anglo Platinum's Waterval and Maandagshoek properties and at Impala's newly acquired Winnaarshoek project. Smaller operations are planned by Aquarius at Marikana and Everest South, and by SouthernEra at Messina.

Anglo Platinum

Anglo Platinum's output of platinum fell by 6 per cent to 870,000 oz during the first half of 2000. Production was affected by a number of factors: heavy rainfall which reduced milling rates during the first quarter, a decline in the average head grade, and problems at the Waterval Smelter. Despite new capacity at Amandelbult and Lebowa, which will come on-stream during the second half, refined platinum output in 2000 is unlikely to match last year's total of 2.02 million oz.

In May 2000, Anglo Platinum unveiled a R12.6 billion investment programme which is intended to increase the group's platinum production capacity from 2 million oz in 1999 to around 3.5 million oz by the end of 2006. Projects are already nearing completion at Amandelbult, Middelpunt Hill and Bafokeng-Rasimone, while the construction of a mine at Maandagshoek began this year. Together these will add over 500,000 oz of platinum to Anglo Platinum's annual total.

Since May, two further projects have been confirmed. In August, it was announced that Anglo Platinum is to enter a 50:50 joint venture with Kroondal which will expand the latter's annual output by around 200,000 oz of platinum. In September, Anglo Platinum revealed plans to develop a new UG2 operation on the farm Waterval; at full capacity, expected to be achieved by the end of 2002, this will contribute 395,000 oz of platinum annually.

Impala Platinum

Between February and April 2000, Impala's mining and milling operations were affected by exceptionally heavy rainfall in the Rustenburg area. This contributed to a 10 per cent fall in refined platinum output to 485,000 oz during the first half of 2000. Production for the full year is expected to fall short of the 1.074 million oz of platinum recorded in 1999.

Outside its existing operations in the Rustenburg area, Impala is involved in two new projects: the re-opening of the mothballed Crocodile River mine (owned by Barplats, in which Impala has an 83 per cent stake), and the development of a major new operation at Winnaarshoek in the Eastern Bushveld.

PGM Supplies: South Africa
'000 oz

	1999	2000
Platinum	3,900	3,920
Palladium	1,870	1,960
Rhodium	410	434

At Crocodile River, open pit mining in the Maroelabult area started in October 2000, and the sinking of a new decline shaft is due to commence in early 2001. Meanwhile, part of the existing concentrator is being rehabilitated, and should start processing ore in January 2001. Platinum output will initially be around 50,000 oz per annum, but may eventually be increased to 80,000 oz.

In June 2000, it was announced that Impala was to acquire the Canadian company Platexco, owner of the Winnaarshoek platinum project. Impala intends to proceed with the development of a new mine, which is expected to produce around 200,000 oz of platinum once it reaches full capacity.

Lonmin Platinum

During the six months to March 2000, mill throughput at Lonmin's platinum operations rose by 10 per cent to 4.8 million tonnes of ore, lifting platinum output by 9 per cent to 306,000 oz. For the full calendar year, Lonmin's output – which has been stable at around 630,000 oz since 1997 – is expected to increase by about 5 per cent.

Lonmin is proceeding with an expansion programme which is designed to raise platinum output to 750,000 oz by 2002, and to more than 800,000 oz by 2007. A new smelter is currently under construction to alleviate a shortage of capacity; it is due to be commissioned during the second half of next year.

Northam Platinum

During the financial year to June 2000, milled tonnage at Northam fell by 8 per cent to 1.8 million tonnes, while the head grade also declined slightly. Total output of precious metals was 270,000 oz, down 9 per cent compared with the 1999 financial year. We expect Northam's platinum production in 2000 to fall below the 190,000 oz level seen in the last two years.

In 2001, the company plans to start mining and processing significant quantities of UG2 ore for the first time. A new UG2 concentrator is scheduled to start operating early in the year, with annual output from the expansion expected to total 95,000 oz of precious metals at full production.

Kroondal Platinum

The new Kroondal Platinum Mine produced just over 50,000 oz of platinum group metals during the first six months of 2000. Output is expected to rise during the second half, as underground ore accounts for a higher proportion of mill feed, and grades and metallurgical recoveries improve.

Kroondal's current mine and plant are designed to achieve an annual production rate of 170,000 oz of pgm, including 100,000 oz of platinum. A tripling of platinum capacity is now planned under a joint venture agreement with Anglo Platinum, which owns mineral rights covering adjacent farms. The UG2 reef underlying these properties will be accessed from Kroondal's existing underground workings, allowing the mine to increase its throughput and extend its life. The existing concentrator will be expanded and a second plant constructed, increasing milling capacity to 5.4 million tonnes of ore per annum.

New Projects

Aquarius Platinum, owner of a 45 per cent share in the Kroondal mine, has a number of other pgm projects on the Bushveld Complex. The most advanced of these is at Marikana, where open pit mining is planned to commence during the first half of 2001. Ore will be stockpiled until the concentrator is commissioned late next year. Annual output is expected to average around 94,000 oz of platinum, 48,000 oz of palladium and 17,000 oz of rhodium once the project reaches full production.

In July 2000 Aquarius acquired three pgm properties from Impala: Everest South, Chieftains Plain, and a portion of Everest North. The first of these projects to be developed will be Everest South, located near Lydenburg in the Eastern Bushveld. Aquarius is carrying out a full feasibility study, and if this proves positive, the company hopes to commence production by the end of 2002.

In 1999, Impala's 54.2 per cent interest in the Messina mine was purchased by SouthernEra Resources, a diamond mining and exploration company listed on the Toronto Stock Exchange. Since then, SouthernEra has increased its stake in Messina to 70.4 per cent and has begun to redevelop the mine. Some of the underground workings have been de-watered and existing mining infrastructure has been rehabilitated, in preparation for trial mining which is due to take place during the final quarter of 2000. Full-scale production is scheduled to start in early 2003, and at full capacity, the mine is planned to produce 160,000 oz of precious metals per annum.

Russia

Russian supplies of platinum and rhodium in 2000 are expected to rise sharply compared with last year, reaching 1.1 million oz and 280,000 oz respectively. Exports of palladium were up slightly during the first eight months of the year, but some of this metal may have been used as collateral for loans. We expect that 5.2 million oz of palladium will be supplied to the market in 2000.

The legislative restriction on exports of platinum and rhodium imposed by Clause 19 of the 1999 Russian Budget was removed early in January by an

PGM Supplies: Russia
'000 oz

	1999	2000
Platinum	540	1,100
Palladium	5,400	5,200
Rhodium	65	280

amendment signed by acting President Putin. However, delays in the granting of export quotas and the issue of export licences continued to affect supplies of these pgm for several months. It was not until May that sales under this year's export quotas were able to commence, although it appears that special dispensation was given for a shipment of rhodium to the USA in January.

There was no interruption of Russian sales of palladium during the first eight months of 2000, although supplies were insufficient to meet market demand. Norilsk Nickel has continued to export palladium steadily, using a ten-year quota and licence granted by presidential decree in March 1999. However, the supply of palladium from government stockpiles, a major feature of recent years, has been erratic. Two possible reasons for the lack of stockpile sales are a delay in granting an export licence to the Central Bank, and the indication that much of the stockpile may have been transferred from the bank back to the Ministry of Finance during the year.

Norilsk Nickel, the principal pgm producer in Russia, has continued to progress the ten-year development plan that was approved by its board in April 1999. Recent progress includes the commissioning of new flotation cells at the Talnakh concentrator. This will enable a higher proportion of the ores mined at Talnakh to be treated locally rather than being sent to the older plant at Norilsk, and should improve recoveries.

The average base metal content of the ores mined in the Talnakh deposits has been declining in recent years and this, together with much higher palladium prices, has changed the economics of mining in the region. This has encouraged renewed exploration in the area of the Norilsk-1 deposit, where the pgm to base metal ratio is higher. An expansion of output at the Zapolyarniy underground mine is underway, and there may be potential to extend the Medvezhiy Ruchey open pit.

In its annual report for 1999, published in June this year, Norilsk Nickel reported profits before tax that were more than ten times those of the prior year. The increase was partly due to a 37 per cent rise in sales income from pgm to more than $1 billion - despite platinum and rhodium to the value of $300 million remaining unsold due to the export restrictions imposed by Clause 19.

While the financial position of Norilsk Nickel has been substantially enhanced by the higher world pgm prices, the same cannot be said of the alluvial platinum producers in the Far East of Russia. The artels of Kondyor and Koryak have been handicapped by their inability to sell all their metal last year, and current production is believed to be running at about two thirds of the peak levels of recent years.

North America

Supplies of pgm from North America are forecast to increase in 2000. In Canada, higher output from Inco and North American Palladium will offset lower shipments from Falconbridge. Output from the Stillwater mine in the USA is expected to be stable.

Stillwater has encountered further delays in the expansion of its Nye mine, with ore production hampered by a lack of developed stopes and the existence of bottlenecks in underground ore handling systems. We expect platinum and palladium output in 2000 to total around 400,000 oz, similar to last year's figure. The company intends to raise mill throughput significantly next year, and forecasts that pgm output from the Nye mine will reach 500,000 oz in 2001. Stillwater is also developing a new mine at East Boulder; the pgm-bearing J-M Reef was intersected in mid 2000, and ore samples have yielded grades similar to those at Nye.

Supplies of pgm from Canada are expected to rise in 2000, due to increases in production at North American Palladium and Inco. In contrast, shipments by Falconbridge are expected to fall sharply following a prolonged strike at its Sudbury operations; this will more than offset increasing output from the company's Raglan mine in Quebec.

Deliveries of pgm by Inco totalled 205,000 oz during the first half of this year, up 26 per cent compared with the same period of 1999, despite a reduction in nickel production from the Ontario Division. Increases in pgm output since 1998 appear to reflect the company's strategy of concentrating on higher-grade ore reserves in the Sudbury area.

At North American Palladium, higher grades boosted palladium output to 46,000 oz during the first half of 2000, up nearly 50 per cent compared with the same period of last year. The company is proceeding with an expansion that will raise the milling rate to 15,000 tonnes of ore per day, yielding 250,000 oz of palladium per annum.

PGM Supplies: North America
'000 oz

	1999	2000
Platinum	270	285
Palladium	630	665
Rhodium	18	20

Platinum

Jewellery

Although high platinum prices have begun to have an impact on fabrication levels in more price-sensitive markets, demand from the jewellery sector has continued to expand during 2000. Higher sales of platinum to Chinese and US jewellery manufacturers will outweigh a decline in fabrication in Japan, with world demand rising by 60,000 oz to 2.94 million oz.

Japan

In Japan, the increased price of platinum has affected demand for inexpensive fashion jewellery. White gold has been gaining a larger share of sales of lightweight products, which are generally purchased by younger consumers for whom design and price are more important than the type of metal. However, retail sales surveys indicate that outside the cheapest category, sales of platinum jewellery were up slightly during the first half of 2000, evidence of platinum's strong position in the higher-value end of the Japanese market.

For the full year, we expect a modest overall decline in unit sales of platinum jewellery at the retail level. However, purchases of platinum by jewellery makers are forecast to fall more sharply. Some manufacturers still had excess platinum inventories at the start of this year, and the trade, generally still weak following the credit crisis and a series of bankruptcies in recent years, has cut back on fabrication levels. As a result, Japanese demand is expected to contract by 170,000 oz to 1.15 million oz.

Europe

Platinum fabrication in Europe is concentrated in four countries: Germany, Italy, Switzerland and the United Kingdom. Statistics from the UK Assay Offices show that the weight of platinum jewellery hallmarked in the UK in the first nine months of 2000 rose by 34 per cent, putting it on course for an annual demand of 40,000 oz. An upturn in the production of platinum watches in Switzerland is mainly due to economic recovery in South East Asian countries which are important export markets for Swiss manufacturers. With small increases in platinum jewellery production in Germany and Italy, total European demand for platinum is expected to rise by 15,000 oz to reach 200,000 oz.

Platinum Demand: Jewellery
'000 oz

	1999	2000
Europe	185	200
Japan	1,320	1,150
North America	330	380
Rest of the World	1,045	1,210
Total	**2,880**	**2,940**

North America

Demand for platinum from North American jewellery manufacturers is forecast to rise by 50,000 oz to 380,000 oz. Platinum is now firmly established as a premium jewellery metal in the USA. Sales of platinum items have increased steadily, mainly on the back of demand from the bridal sector, although the range of necklaces and other jewellery accessories on offer has been expanding gradually. The only discernible effect of higher metal prices has been to make it harder for American manufacturers to meet the price targets which mass market retailers set for the products they

sell. This has been an incentive for increasing imports of lower priced platinum jewellery, particularly from China and India.

Rest of the World

Fabrication of jewellery in China has continued to expand and is expected to reach 1.1 million oz in 2000, an increase of over 15 per cent. While consumer demand for white metal jewellery remains extremely strong, high platinum prices have slowed the rate of growth in fabrication. Retail prices for platinum have edged up only slowly in response to higher bullion prices, and some manufacturers have found it difficult to maintain profit margins. Consequently they have been meeting some of the demand for white metal products by increasing their use of white gold, mainly at the cheaper end of the market. Nevertheless, platinum remains the preferred metal for white jewellery in general and for wedding rings and settings for good quality diamonds in particular.

Demand in the remainder of the Rest of the World region will be boosted by rising fabrication levels in India. Here, manufacturing of platinum jewellery takes place in the country's special duty-free export zone, and several Indian manufacturers are now exporting platinum jewellery to the USA. Excluding China, demand in the Rest of the World is forecast to grow by 15,000 oz to reach 110,000 oz this year.

Autocatalyst

Sales of platinum to auto makers are expected to rise by 190,000 oz to 1.8 million oz in 2000. Tighter emissions legislation and higher car output will boost consumption in Europe, Japan and the Rest of the World region. In North America, actual use of platinum in catalysts will decline, but demand will be augmented by purchases of platinum for strategic stocks.

Europe

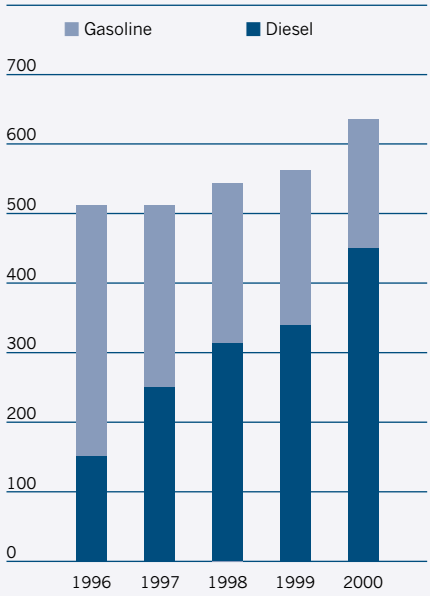
European demand for platinum in autocatalysts is forecast to rise by 70,000 oz to 630,000 oz in 2000. With European car production and sales expected to rise only slightly this year, legislation will be the main influence on pgm use. Stage III EU legislation was introduced for new models from January 2000, and will affect all new vehicles from the beginning of next year. However, many vehicle manufacturers have opted for early compliance with the new regulations; indeed, some are already fitting cars with catalysts capable of meeting even stricter emissions limits. We estimate that over 50 per cent of cars sold in Europe this year will meet Stage III or tighter standards.

For platinum, the principal impact of the new legislation has been in the diesel sector. Average platinum loadings have increased sharply, and this - combined with a 13 per cent increase in sales of diesel cars - is expected to increase the use of platinum on diesel vehicles by almost a quarter in 2000. In contrast, demand for platinum in the gasoline sector will decline this year, since most manufacturers have chosen to use palladium-rich catalysts to meet Stage III limits for these vehicles. In recent years there has been a significant switch from platinum to palladium technology on gasoline cars in Europe:

Platinum Demand: Autocatalyst
'000 oz

	1999	2000
Europe	560	630
Japan	250	275
North America	535	590
Rest of the World	265	305
Total	**1,610**	**1,800**
Autocatalyst recovery	**(425)**	**(460)**

European Demand for Platinum in Autocatalysts 1996-2000
'000 oz



this is now essentially complete. Looking ahead, high palladium prices and concerns over the security of supplies are encouraging car companies to reassess their catalyst strategies, and from next year we expect to see the start of a gradual return to platinum.

Japan

Changes in legislation have had a positive impact on platinum demand in Japan this year. Japanese Low Emission Vehicle (JLEV) standards were imposed from October 2000, but even before this deadline many car companies were fitting vehicles with catalysts capable of meeting the new standards. With the introduction of JLEV, some companies have chosen to increase loadings of platinum rather than of palladium, in order to bring the pgm mix in their catalysts closer to mine production ratios.

A recovery in the Japanese auto market has also played a role in boosting platinum demand, with both sales and production of passenger cars expected to rise by around 5 per cent in 2000. Total consumption of platinum by

Japanese auto makers is forecast to rise by 25,000 oz to 275,000 oz this year.

North America

Sales of platinum to US auto makers are forecast to increase by 55,000 oz to 590,000 oz in 2000. However, this total includes some additions of platinum to strategic stocks; actual use of platinum on autocatalysts is expected to fall slightly this year.

The decline in underlying consumption is due to the adoption of palladium-rich catalyst systems in order to meet Low Emission Vehicle (LEV) standards, a trend which has reduced platinum demand in this region by almost a third from its peak of 850,000 oz in 1996. We expect platinum to begin to regain ground from next year, with some car companies planning to add platinum to their catalyst systems in order to reduce their dependence on palladium.

Rest of the World

In the Rest of the World region, demand for platinum in autocatalysts is forecast to rise by 40,000 oz to reach 305,000 oz. This gain is due to a combination of rising vehicle output and tightening emissions legislation, partly offset by further adoption of palladium-rich technology in some markets.

Demand for platinum from Korean auto makers is set to rise this year, with the introduction of stricter emissions standards from January 2000 leading to an increase in platinum loadings. India also tightened its emissions legislation at the beginning of this year, moving to standards based on European Stage II, while in China standards equivalent to EU Stage I were applied across the whole country for the first time.

In Latin America, platinum consumption will be little changed this year. Although sales to auto makers in Brazil and Argentina will rise, principally due to higher vehicle output, this will be offset by lower demand in Mexico. Many vehicles produced in Mexico are destined for sale in the USA, and there has been an increase in the use of palladium-rich catalysts to meet US LEV legislation.

Autocatalyst recovery

The recovery of platinum from spent autocatalysts is forecast to rise by 35,000 oz to 460,000 oz in 2000. Most of this metal will come from vehicles scrapped in North America and Japan, although autocatalyst recovery is gradually becoming more significant in other regions.

In the USA and Japan, a high proportion of scrapped vehicles have their catalytic converters removed and recycled. Variations in the amount of platinum recovered therefore reflect changes in the number of vehicles reaching the end of their lives, and the amount of platinum on the catalysts. In 2000, autocatalyst recovery of platinum in North America is forecast to rise by 6 per cent to 340,000 oz. This reflects increases in platinum loadings that took place following changes in Federal emissions legislation in the early 1990s. In Japan, the recovery of platinum from spent autocatalysts is forecast to be stable this year, with weak economic conditions encouraging consumers to keep their vehicles longer before scrapping them.

European recovery of spent autocatalysts is concentrated in Germany; in the region's other large auto markets, only a small proportion of catalyst scrap is collected and reprocessed. Nevertheless, platinum recoveries in Europe are expected to rise in 2000, mainly because vehicles scrapped this year are more likely than in the past to carry a catalyst.

Industrial

Industrial demand for platinum is forecast to increase by 105,000 oz to 1.46 million oz in 2000, with rising consumption in the electrical and glass sectors offsetting lower use in the chemical industry.

Demand for platinum in the **chemical** industry is forecast to decline by 50,000 oz to 270,000 oz in 2000. The European nitric acid sector remains depressed due to the availability of low-priced ammonium nitrate fertiliser from former Soviet countries. This has resulted in the closure of nitric acid plants in several countries, including the UK, Sweden and France. The market has also been weak in the USA, with smaller nitric acid plants being closed in favour of larger, more cost-effective facilities. In the process catalyst sector, the production of speciality silicones continues to dominate platinum demand; consumption in this application is expected to show modest growth this year. However, this will be offset by a fall in sales of platinum catalysts used in the manufacture of paraxylene.

In the **electrical** sector, demand is predicted to expand by 90,000 oz to 470,000 oz in 2000. The key contributor to this growth is the computer industry, which uses platinum in hard disks in order to improve data storage capacity. This year, we believe that more than 90 per cent of all hard disks will use platinum, up from around 75 per cent in 1999. The average platinum content of each disk is also rising as manufacturers

Platinum Demand: Industrial
'000 oz

	1999	2000
Chemical	320	270
Electrical	380	470
Glass	205	245
Petroleum	115	110
Other	335	365
Total	**1,355**	**1,460**

strive to offer greater storage capabilities. In addition to these technical factors, demand has been boosted by strong growth in the personal computer market: sales of PCs are reported to have risen by more than 15 per cent in the first half of 2000.

Other electrical applications will make a more modest contribution to higher demand. Growth in worldwide auto production has boosted steel output, thereby increasing consumption of platinum in thermocouples. Demand for platinum in fuel cells has also risen, though the total is still small. Major automotive and petroleum companies continue to invest heavily in fuel cell research, and obstacles to commercialisation are gradually being overcome. The choice of fuel remains a key issue, and this year several industry partnerships have announced plans to develop on-board reformers that will enable fuel cell cars to use liquid fuels such as methanol or gasoline. During 2000, a number of major car companies have demonstrated vehicles powered by fuel cells, though current prototypes generally carry a hydrogen tank rather than an on-board reformer.

Demand for platinum in the **glass** industry has benefited from the boom in the personal computing sector, with strong demand for liquid crystal displays (LCDs) used in laptop and hand-held computers, and digital cameras. LCDs are also finding increasing use in desktop PCs and televisions, which typically have wider screens and therefore require larger glass panels. As a result, LCD glass manufacturers in Germany, Japan, Korea and the USA are adding capacity at the moment. Total demand from the glass industry is expected to rise by 40,000 oz to reach 245,000 oz in 2000.

Sales of platinum to the **petroleum refining** industry, at 110,000 oz, will be similar to last year. Consumption in the Rest of the World region has again been strongest, largely due to purchases of catalyst for new refineries in India.

Other applications are expected to consume 365,000 oz of platinum in 2000, a rise of 30,000 oz. This demand sector continues to be dominated by platinum's non-catalytic automotive applications. In Europe, the use of platinum in oxygen sensors has been boosted by the imposition of Stage III automotive emissions legislation. Under these regulations, manufacturers have been required to fit on-board diagnostic systems to all new models since January 2000; this has led to an increase in the average number of sensors per vehicle. The use of platinum in spark plugs is also rising, as manufacturers adopt long-life components which are consistent with servicing intervals and durability requirements for modern vehicles.

Platinum Demand: Investment
'000 oz

	1999	2000
Coins and small bars		
Europe	5	0
Japan	20	10
North America	60	35
Rest of the World	5	0
	90	**45**
Large bars in Japan	**90**	**(95)**
Total	**180**	**(50)**

JM

Investment

Net demand for platinum in investment products is forecast to be negative this year. Higher bullion prices have encouraged Japanese investors to sell substantial quantities of platinum, in the form of large bars, back to the market. Sales of bullion coins have fallen sharply, although demand for proof coins is likely to be stable this year.

Demand for platinum in coins and small bars is expected to halve in 2000 to just 45,000 oz. This figure assumes that the US Mint will sell all of this year's issue of 26,850 oz of proof platinum Eagles, which went on sale late in September. Sales of platinum bullion coins have fallen again this year; few Australian Koalas or Canadian Maple Leafs have been minted, while sales of bullion platinum Eagles amounted to only 18,000 oz during the first nine months of 2000, down from 59,000 oz in the same period in 1999.

Since its launch in 1997, the US Mint's platinum Eagle programme has been supported by a loan of just under 200,000 oz of metal from the US Defense Stockpile, which has provided a working pipeline of metal. However, in February this year it was reported that the Defense Logistics Agency (DLA) had requested the return of this platinum, part of which will be sold under its Annual Materials Plan for the fiscal year to October 2001. The withdrawal of the loan creates a problem for the US Mint, which will need to buy metal if it is to continue minting platinum coins. In these circumstances, the production of bullion coins may no longer be viable, although the higher mark up on proof Eagles should enable the Mint to continue this programme, which is currently scheduled to run until 2002.

As a result of much higher platinum prices, demand for large platinum bars in Japan is forecast to be negative this year. During the first nine months of 2000, new purchases of 500g and 1kg bars by Japanese investors were substantially outweighed by the selling back of bars bought in earlier years at lower prices. Assuming that the price of platinum remains close to ¥2,000 per gram, the level recorded at the end of September, we believe that net sales of platinum bars back to the market will total 95,000 oz this year.

Palladium

Autocatalyst

Demand for palladium in autocatalysts is forecast to fall by 720,000 oz in 2000, the first decline for more than a decade, to 5.16 million oz. In 1998 and 1999, several auto makers built substantial stocks of palladium, but this year some have drawn from these stockpiles, especially at times of highest prices. Despite the fall in purchases by the auto industry, the amount of palladium used in catalysts this year will increase by just over 20 per cent as more cars are manufactured to meet tighter emission standards in the USA, Europe and Japan.

Europe

Demand for palladium in Europe is expected to increase by 19 per cent this year to 1.82 million oz, largely in response to the introduction of Euro Stage III legislation from January 2000. Most auto makers are using palladium-rich catalysts to meet these stricter limits for gasoline models, resulting in a further move away from platinum technology. At the same time, average pgm loadings have increased to meet the new standards. These factors have substantially outweighed a slight decline in sales of gasoline cars, caused by a shift in consumer preferences towards more fuel-efficient diesel vehicles.

Japan

Some Japanese auto makers added to their stocks of palladium in 1999 but we do not expect them to do so again in 2000 and, as a consequence, demand is expected to fall by 18 per cent to 490,000 oz. In October this year, Japan introduced new, stricter emissions legislation (JLEV) and this has resulted in heavier loadings of palladium in catalysts on cars for the domestic market, although the full impact will not be felt until next year. More palladium has also been used in catalysts fitted to cars exported to the USA to meet the LEV regulations there: exports to North America in the first six months of 2000 were up 14 per cent on last year.

The longer term outlook for palladium use in autocatalysts in Japan is not clear. The requirement to produce low emissions vehicles to comply with JLEV and overseas regulations would seem to favour palladium. However, there are signs that some Japanese auto companies, driven by concerns about the future price and availability of palladium, will add platinum to catalyst systems fitted to new models.

Palladium Demand: Autocatalyst
'000 oz

	1999	2000
Europe	1,530	1,820
Japan	600	490
North America	3,490	2,430
Rest of the World	260	420
Total	**5,880**	**5,160**
Autocatalyst recovery	**(195)**	**(230)**

North America

In North America, demand for palladium by the auto industry in 2000 is forecast to decline by 30 per cent to 2.43 million oz. In recent years, in anticipation of substantially increased use of palladium,

most auto makers built up stocks of the metal, in order to protect against price rises and uncertainty about the future availability of palladium. Significant additions were made in 1999, but this year we have seen a significant reversal of this policy, with manufacturers drawing substantially from these stocks, especially at times of the highest prices for palladium.

Despite the fall in purchases by auto makers, the actual use of the metal in catalyst systems fitted to cars and trucks in North America in 2000 will increase by around 450,000 oz, in order to meet the tighter standards now in place. During the year, several of the major US auto companies have indicated that they wish to reduce their dependence on palladium and it seems likely there will be moves to try to bring overall pgm use in autocatalysts closer to mine mix. However, even if such moves are successful, the ever tightening regulations on hydrocarbon control in the USA will almost certainly ensure that palladium continues to be an essential component of most autocatalyst systems.

Rest of the World

Demand for palladium in the Rest of the World is expected to increase by 160,000 oz this year to 420,000 oz. Production of cars is significantly higher than last year in many countries in Asia that have catalyst enforcing legislation, with particularly strong gains in Malaysia, India and China. In addition, growth in production of trucks in Mexico has led to increased demand for palladium in catalysts.

Autocatalyst recovery

Recovery of palladium from scrapped autocatalysts is expected to rise by 35,000 oz in 2000 to reach 230,000 oz. The dramatic increase in the use of palladium in autocatalysts did not begin until the middle 1990s and therefore it will be at least a further 2-3 years before this change is reflected in significant increases in the amount of metal recovered from spent catalysts.

Electronics

Demand for palladium in electronics is expected to grow by 5 per cent to reach 2.07 million oz in 2000. This increase is somewhat surprising given that the high price of palladium might have been expected to accelerate its substitution by lower cost materials. However, much greater production of the electronic components in which palladium is used and a reduction in the amount of scrap being recovered are forecast to result in an increase in demand of 90,000 oz.

Worldwide production of multi-layer ceramic capacitors (MLCC) is forecast to grow by 50 per cent to 630 billion in 2000. This massive growth in output has outweighed a further increase in the substitution of palladium by nickel in the electrode layers of these capacitors.

Japan accounts for just over half of global MLCC production and has traditionally used high palladium content pastes to manufacture electrodes. Substitution with nickel has advanced strongly and is expected to exceed 60 per cent in Japan this year. Despite this change, demand for palladium in Japan is expected to remain virtually unaltered from that of 1999, due to the increase in MLCC production.

In the countries of South East Asia, which together now comprise the second largest producing area for MLCC, similar rates of substitution of palladium by base metal have been achieved to those in Japan. However, a near 70 per cent increase in output of MLCC in the region has resulted in demand for palladium increasing significantly in 2000.

The growth of MLCC production in North America this year will be lower than in other regions, at around 20 per cent. Manufacturers here have traditionally used silver-palladium pastes with a higher silver content to make MLCC electrodes: as a result, cost pressures have been less intense in this region and substitution of palladium by base metals has progressed more slowly.

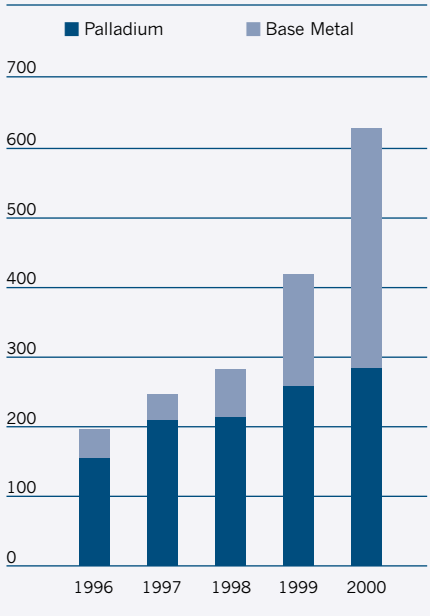
The use of palladium pastes for the conductive elements of hybrid integrated circuits (HIC) has also been affected by the higher price of the metal and demand has declined by about 10 per cent this year as manufacturers have moved to silver-palladium pastes with higher silver

Palladium Demand: Electronics
'000 oz

	1999	2000
Europe	255	260
Japan	980	975
North America	395	415
Rest of the World	350	420
Total	**1,980**	**2,070**

JM

MLCC Production by Electrode Type
Billions



contents. In other electronic applications of palladium, such as the plating of connectors and lead frames, price is also an issue but demand has changed little.

Some further substitution of palladium by gold in the plating of connectors has been encouraged by the widening of the price differential between the two metals, but increases in production of these components have more than compensated for the lower intensity of palladium use. Palladium is also still preferred where high reliability is essential.

The high price of palladium is discouraging lead-frame manufacturers seeking an alternative to tin-lead solders from switching to palladium. However, those that have already made the change have continued to use palladium and demand this year is virtually unaltered.

A consequence of the efforts to miniaturise, and minimise the cost of, electronic goods in recent years has been the gradual thrifting of precious metals from electronic components. One result of this is that the content of palladium in manufacturing scrap and old scrap is steadily diminishing. Thus, although the substantial increase in the price of the metal, and the growth of component production, has resulted in increased volumes of scrap being collected for refining, we believe that the amount of palladium that will be recovered will fall by around 20 per cent this year.

Dental

The use of palladium in dental alloys has been severely affected by the rising price of the metal. Although the impact of price has not been uniform across the main consuming countries, overall demand is expected to fall by 22 per cent to 870,000 oz in 2000.

In both Europe and North America there has been a significant shift away from high-palladium alloys in dental treatment, with substitution by either gold alloys or base metals. In Europe demand is expected to fall by 39 per cent in 2000 to 110,000 oz, and in North America the decline is predicted to be 34 per cent to 230,000 oz.

Palladium Demand: Dental
'000 oz

	1999	2000
Europe	180	110
Japan	545	510
North America	350	230
Rest of the World	35	20
Total	**1,110**	**870**

JM

In Japan, the largest market, the situation is different: demand has fallen this year, but only by 6 per cent to 510,000 oz. In April, the Japanese government introduced a new system for the compensation of patients under the state insurance scheme. The cost of the components of the standard gold: palladium alloy used for dental restorations covered by this system is now monitored and the payment made is adjusted every six months in line with the cost of these materials. It therefore seems likely that the use of palladium in dental alloys will remain firmer in Japan than in other countries.

Other

Demand for palladium in other applications will decline by 55,000 oz this year to 530,000 oz. Although purchases by the chemical industry have increased marginally, there have been substantial falls in consumption in other sectors in response to higher palladium prices.

The use of palladium as a minor alloy component in platinum jewellery alloys has been subject to conflicting pressures. Increased demand for platinum in jewellery is positive for palladium demand, but the continuing high price of the metal is encouraging some jewellery makers, notably in China, to seek alternatives to palladium as an alloy component. In some instances this has been achieved by increasing the platinum content of the alloys, but for the most part, palladium has been substituted by other metals such as copper or cobalt.

Palladium is widely used as a whitening agent in white gold jewellery alloys. However, as white gold is often regarded as a cheaper alternative to platinum, manufacturers are naturally reluctant to include a metal that is currently more expensive than platinum, and are seeking less expensive substitutes for palladium.

Demand for palladium in the chemical sector is expected to grow by 20,000 oz this year to reach 260,000 oz. During 2000 there has been a significant investment in new plant to produce vinyl acetate monomer using palladium catalysts.

In contrast, demand for other minor applications is forecast to fall by 50,000 oz, mainly due to the replacement of palladium by base metals in some hydrocracking catalysts used in petroleum refining. The reasons for this are mixed, with some oil companies aiming to produce different refined products in response to market changes, and others indicating that the higher palladium price has been a factor.

Palladium Demand: Other
'000 oz

	1999	2000
Chemical	240	260
Jewellery	235	210
Other	110	60
Total	**585**	**530**

JM

Other Platinum Group Metals

Rhodium

Rhodium demand is expected to reach 573,000 oz in 2000, an increase of 9 per cent compared with last year. Sales of rhodium to auto makers will rise strongly, although this will be partly offset by continued increases in recovery from spent catalysts. Glass demand will also increase, while consumption in other industrial applications will be stable.

Autocatalyst

Automotive demand for rhodium is forecast to rise by 54,000 oz to 563,000 oz in 2000, boosted by higher vehicle production, tighter emissions legislation and changes in the pgm mix in autocatalysts. Our estimate of total demand assumes that there have been no significant increases in auto makers' stocks of rhodium this year, although it is probable that part of a large Russian shipment to the USA in January was acquired by a car company.

In the world's three major auto markets, North America, Europe and Japan, total vehicle output is expected to grow by 2-3 per cent in 2000. Meanwhile, some Asian and Latin American markets have recorded rapid growth this year. For example, passenger car production is forecast to expand by more than 15 per cent in Brazil, China and India, all of which now have legislation requiring new cars to be fitted with catalysts.

Changes in emissions legislation have played a significant role in boosting rhodium demand this year, especially in Europe and Japan. Stage III European emissions legislation came into force in January 2000, leading to an increase in average rhodium loadings. In addition, we estimate that about 10 per cent of vehicles sold in 2000 will meet tougher emissions standards. Although EU Stage IV regulations will not take effect until 2005, fiscal incentives offered by the German government have encouraged some car companies to fit catalysts capable of meeting stricter limits.

Japan has also seen an increase in rhodium demand in response to new legislation. Japanese Low Emission Vehicle (JLEV) regulations were imposed in October 2000, but many manufacturers had adopted catalysts capable of meeting the new limits ahead of this deadline. Loadings on export models have also increased, in line with tightening emissions limits in Europe and the USA.

Rhodium Supply and Demand
'000 oz

	1999	2000
Supply		
South Africa	410	434
Russia	65	280
North America	18	20
Others	8	3
Total Supply	**501**	**737**
Demand		
Autocatalyst: gross	509	563
recovery	(66)	(79)
Chemical	34	35
Electrical	6	6
Glass	30	37
Other	11	11
Total Demand	**524**	**573**
Movements in Stocks	(23)	164

In North America, changes in catalyst technology have been an important influence on rhodium demand in 2000. High palladium prices have encouraged some manufacturers to add rhodium to their catalyst systems in order to thrift palladium and reduce overall cost.

The recovery of rhodium from spent autocatalysts continues to grow, with the total expected to increase by 20 per cent to 79,000 oz in 2000. This growth reflects increases in rhodium loadings which occurred in the early 1990s.

Other Demand

Demand for rhodium in other industrial applications is forecast to increase by 8,000 oz to reach 89,000 oz in 2000. Sales to the glass sector are expected to rise sharply this year, as manufacturers in Asia, North America and Europe expand their capacity to produce high-quality thin glass for liquid crystal displays (LCDs). Consumption in other applications will be stable.

Ruthenium & Iridium

Exceptional growth in the world electronics industry has contributed to growth in ruthenium demand, which is forecast to rise by 33,000 oz to 428,000 oz in 2000. Iridium demand is expected to fall by 7,000 oz to 95,000 oz, with lower use in autocatalysts outweighing an increase in demand for iridium crucibles.

Ruthenium pastes are used in the manufacture of resistors, which are found in virtually all electronic devices. This year, world output of resistors is

Ruthenium Demand by Application
'000 oz

	1999	2000
Demand		
Chemical	86	68
Electrochemical	72	80
Electronics	196	232
Other	41	48
Total Demand	**395**	**428**

Iridium Demand by Application
'000 oz

	1999	2000
Demand		
Automotive	34	14
Chemical	7	6
Electrochemical	28	24
Other	33	51
Total Demand	**102**	**95**

expected to rise by over 30 per cent, reflecting a surge in sales of products such as mobile phones, personal computers and digital cameras. Ruthenium demand will increase at a lower rate, around 18 per cent, due to the impact of miniaturisation.

The boom in the mobile phone market has also boosted demand for iridium crucibles, used to grow crystals for electronic applications. These crystals are used in electronic components known as surface acoustic wave (SAW) filters, which are designed to prevent interference between cell phones.

In the electrochemical sector, demand for ruthenium has risen slightly, while that of iridium has fallen. Although the chloralkali industry as a whole remains depressed, sales of ruthenium have been boosted this year by the recoating of old, ruthenium-only electrodes at some US plants.

The use of ruthenium in chemical applications is expected to decline slightly this year. In recent years, there has been significant consumption in a catalyst used in the Kellogg Advanced Ammonia Process (KAAP); purchases have continued in 2000, but at a lower level than last year. Sales of iridium to the chemical industry – largely for a catalyst used in acetic acid production – will be little changed in 2000.

Consumption of ruthenium in other applications is forecast to rise this year. Ruthenium is used as an alloying element in titanium piping for deep water oil installations; demand is increasing as higher oil prices encourage the reinstatement of mothballed projects.

There will be a sharp decline in the use of iridium in autocatalysts this year. Following the introduction of Japanese Low Emission Vehicle standards, iridium catalysts are being replaced with platinum-rich catalysts on gasoline direct injection vehicles sold in Japan.

Supplies

Rhodium

For 2000, we forecast a very substantial increase in rhodium supplies, up 236,000 oz to 737,000 oz. Clause 19 of Russia's 1999 budget bill was amended in January, clearing the way for the resumption of platinum and rhodium exports; sales of rhodium are expected to total 280,000 oz in 2000, more than four times last year's total. South African supplies are also expected to rise this year.

Despite this overall increase in supplies, there was a shortage of physical availability for much of the first nine months of 2000. Combined with strong consumer demand, this drove the price up to an eight year high of $2,600 in August. The Russians were absent from the market for much of this period, although there was a surge of selling in April and again in September; on both occasions, the price quickly retreated to around $1,700.

While offers of spot metal have been very intermittent, trade statistics reveal that around 160,000 oz of Russian rhodium were imported by the USA in January. This shipment had no impact on market liquidity, and it seems likely that some or all of the metal was acquired by an auto company, either directly from Almaz or through an intermediary.

Supplies of rhodium from South Africa are forecast to rise by 24,000 oz to reach 434,000 oz in 2000. Whereas last year's shipments were slightly below refined output, this year we believe that South African producers have sold some metal from stocks, taking advantage of higher prices while the Russians were absent from the market.

Ruthenium & Iridium

While supplies of iridium have been sufficient to meet demand, there has been a shortage of liquidity in the ruthenium market this year - even though world production of this metal is sufficient to meet current consumer demand. Sales by South African producers are expected to be lower than refined output in 2000, while Russian exports of ruthenium were negligible during the first eight months of the year. An increase in speculative buying has also contributed to the tightness in the market, with investors purchasing in response to predictions of increasing demand for new industrial applications.

Prices

Platinum

Platinum made strong gains during the first nine months of 2000, rising from a low of $414 in January to a high of $612, a level which was reached first in August and again in September. During the early part of the year, uncertainty over Russian exports was the key factor behind the rally. Although Almaz made intermittent sales from May onwards, platinum maintained its gains, supported by strong consumer demand and limited physical availability. It was also influenced by dramatic gains in the palladium price, and by expectations that this would encourage higher use of platinum in autocatalysts.

Platinum declined sharply in early **January** 2000, falling from $442 on the first day of trading on the 4th to $414 on the 6th - the lowest price recorded in the first nine months of the year. The fall was in response to news that Vladimir Putin, then acting President of Russia, had signed a revision to Clause 19 of the 1999 budget bill. This amendment provided the legal framework for the resumption of platinum exports (which had been held up since April 1999), and prompted selling by both dealers and funds. From mid month onwards, bullish sentiment returned as it became clear that regular shipments would not resume immediately. Consumer demand was also strong and there was an increasing physical shortage of metal, with lease rates rising from 30 per cent on the 13th to over 75 per cent on the 28th. The price rose strongly, reaching $495 at the month end.

Despite a steady decline in lease rates, platinum continued to climb during the first three weeks of **February**, peaking at an eleven year high of $573 on the 17th. Continued concerns about delays in Russian shipments stimulated heavy buying on TOCOM, with the exchange recording an exceptional trading volume of 2.6 million oz on the 9th. Meanwhile, the rally was reinforced by sharp gains in the palladium price, which recorded a series of all-time highs before peaking at $800 on the 21st. However, platinum's gains were quickly eroded. Expectations of an imminent resumption of Russian platinum exports caused the price to retreat to $465 on the 25th, although it recovered to $490 at the month end.

Platinum dipped to $463 on 2nd **March**, responding to reports that Vladimir Putin had signed a decree enabling the start of platinum shipments. This decline was short-lived: rising lease rates, a continued lack of Russian material in the market, and strikes at two South African producers saw the price bounce back to $496 on the 22nd. It retreated slightly at the month end, slipping to $482 on the 31st.

April saw some wide swings in the platinum price. It spiked to $521 on the 5th, stimulated by strong consumer demand and fund buying on NYMEX, then sank back to $488 on the 10th. Over the next two weeks, the price swung between $470 and $510, responding to conflicting reports about Russian sales. From the 27th onwards, platinum began a rapid ascent, surging to $525 on the 28th. The rally was prompted by a continued lack of Russian material in the market, combined with a renewed rise in lease rates to over 70 per cent.

During the first half of **May**, lease rates fell back to 45 per cent, and the price also retreated, trading just above $500. Physical demand provided strong support at this level, and an announcement by Amplats (now Anglo Platinum) that it would increase annual platinum production by 1.5 million oz by 2006 had

Average PGM Prices in $ per oz

Average		Platinum	Palladium	Rhodium	Iridium	Ruthenium
January - September	1999	359.04	343.17	897.50	414.77	39.69
January - September	2000	528.93	640.76	2,025.47	415.00	118.72
Percentage Change		47%	87%	126%	0%	199%

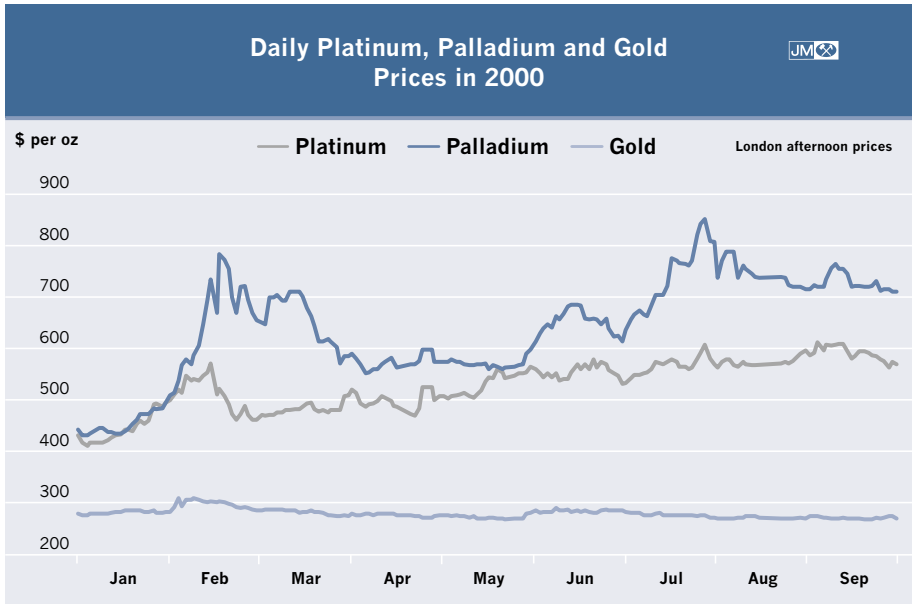
Platinum and palladium prices are averages of London am and pm fixings. Other pgm prices are averages of Johnson Matthey European base prices.

no impact on the price. In mid month, platinum embarked on another climb, soaring to $563 on the 24th. The rally was motivated by market expectations of higher demand in autocatalysts, following news that General Motors was planning to increase its use of platinum by 10 per cent by 2002. The price was subsequently supported at around $550 by a report suggesting that Gokhran, Russia's State Fund, would not export any platinum this year.

Platinum slid to $540 in mid **June**, as a fall in lease rates to 30 per cent stimulated some long liquidation by investors. This decline was quickly reversed; the price surged to $580 on the 27th, with fund purchasing in a thin market the main factor behind the rally. In addition, there was still concern about Russian supplies - especially among Japanese investors - despite the release of Swiss trade statistics showing the import of 224,000 oz platinum from Russia in May.

Early **July** saw another dip in the platinum price, which dropped to $532 on the 5th in response to Russian selling. However, a remarkable rally in palladium - which gained over $200 during the month – helped platinum recover the $580 level by the end of July. Concerns that supplies of pgm from Russia would prove insufficient were the main influence on the markets, while platinum was also bolstered by continued consumer demand.

Prices for both metals jumped higher at the start of **August**, triggered by a lack of Russian metal in the spot market. Palladium recorded an all-time high of $855 on the 2nd, lifting platinum to a peak of $612 – its highest fixing since December 1988. The rally ended abruptly, however, with reports that Norilsk Nickel expected contract shipments to Japan to commence in September or October. Platinum dropped swiftly to $564 on the 7th, before trading around $570 for the next three weeks.



Lower prices stimulated strong buying from consumers, which lifted the price to $598 on the 30th.

Platinum continued to make gains in early **September**, revisiting its high of $612 on several occasions. However, the price began to weaken from mid month, despite the start of strike action at Amplats' mines. The decline appeared to be triggered by concern over rising fuel prices and the potential impact on the world economy; this encouraged some investors to liquidate long positions on NYMEX and TOCOM. At the month end, platinum recorded a fixing price of $569.

Palladium

The first nine months of 2000 saw dramatic movements in the palladium price. After starting the year at around $440, palladium embarked on a remarkable ascent triggered initially by strong industrial demand and a shortage of metal from Russia. As the price rose, the rally was given impetus by investors scrambling to cover short positions on TOCOM, and palladium spiked to a record $800 on 21st February. It subsequently eased back below $600, but another lull in Russian sales sparked a fresh rally during July. In early August, palladium peaked at a new all-time high of $855 before retreating back towards $700 in late September.

After trading at around $440 during the first two weeks of **January**, palladium began to rally strongly during the second half of the month. Driven by strong consumer demand and a shortage of metal from Russia, the price rose steadily to reach $488 on the 28th.

Palladium's ascent steepened during **February**, with the price setting a series of all-time highs culminating in a London fixing of $800 on the 21st. This remarkable gain was largely due to panic buying on TOCOM, where investors were reported to hold short positions totalling around 650,000 oz. Attempts at short covering only added to the rally's momentum, causing palladium to repeatedly open limit-up on TOCOM and making it almost impossible for investors to close out their positions. On the 23rd, the exchange authorities suspended trading of palladium futures, and froze prices in order to prompt the orderly liquidation of contracts. The following day, Japanese traders closed out 225,000 oz of their long positions, and the palladium price fell abruptly to $700.

The decline was arrested by continued shortages of physical metal,

which helped to support palladium at around $700 for much of the first three weeks of **March**. From the 20th onwards, the price began to fall steeply, sinking to $573 on the 31st in line with a significant improvement in physical availability. Initially, Russia was rumoured to be the source of the additional metal, but news that Tiger Management was to close its largest fund led to speculation that it had liquidated its remaining palladium holdings.

The price continued to retreat in early **April**, dipping to a low of $553 on the 11th. It recovered to $600 on the 28th, but lost ground again during **May**, falling to a low of $560 on the 22nd. This decline was mainly due to increased liquidity in the market, although sentiment was also affected by Swiss trade data showing the import of over 1 million oz of Russian palladium in March. Market rumour suggested that this metal may have been used as collateral for a loan, rather than being sold.

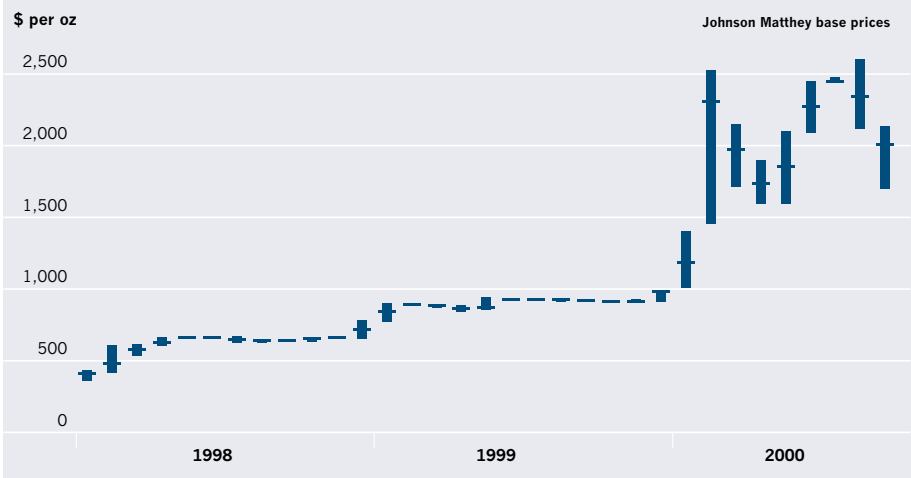
Palladium staged a strong recovery during **June**. It reached $691 on the 19th, boosted by strong physical demand, a jump in lease rates, and a bout of short covering on TOCOM (which in April had lifted trading restrictions on palladium contracts for delivery in February 2001 and later). The price then began to drift lower, weakening to a fix of $635 on 30th June.

This retreat was short-lived, with the rally finding renewed impetus during **July**. Once again, the triggers were a combination of strong consumer purchasing and a lull in Russian sales; as the price climbed, short covering added to the momentum. On the 17th, palladium breached the $700 level for the first time since March, and it continued steeply upwards to a fresh all-time peak of $822 on the 31st.

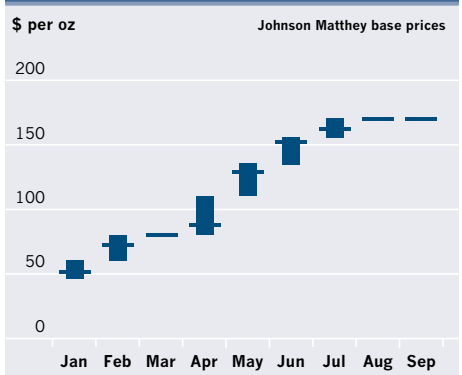
The rally culminated on 2nd **August**, with palladium spiking to a new record fix of $855. After reaching this peak, the price immediately went into a steep decline, plunging to $716 by the month end. Sentiment was affected by press reports indicating that Russian exports to Japan could commence the following month, and by news that the US Defense Logistics Agency planned to sell an additional 100,000 oz of palladium from its stockpile before the end of September.

Palladium bounced briefly back to $765 on 8th **September**, responding to strong industrial buying and a continued shortage of metal. But during the second half of the month, more Russian palladium came onto the market, and the price began to drift lower. It recorded $712 at the month's final London fix.

Monthly High, Low and Average Prices of Rhodium January 1998 - September 2000



Monthly High, Low & Average Prices of Ruthenium in 2000



Other PGM

Strong consumer demand and a lack of availability boosted rhodium to an eight year peak of $2,600 in August. The price weakened to $1,700 in September, in line with increased sales from Russia. Meanwhile, industrial and speculative buying propelled ruthenium to a high of $170 in August.

The Johnson Matthey base price for **rhodium** climbed steeply from $1,000 at the start of 2000 to $2,525 in February. The rally was underpinned by strong demand from Asia, particularly from car companies, coupled with a lack of physical availability. There were also reports of speculative purchasing.

These gains were eroded during March and April, with the price slipping back to $1,600. However, strong consumer demand combined with a shortage of metal then led rhodium higher. The price peaked at an eight year high of $2,600 in August but the following month saw increased Russian selling and rhodium sank to a JM base price of $1,700 on 29th September.

While the JM base price for **iridium** was unchanged at $415 during the first nine months of 2000, **ruthenium** saw some significant gains. Propelled by buying from consumers and speculators, the price rose from $46 at the beginning of the year to reach $170 in August.

Supply and Demand Tables

Notes to tables

Supply figures are estimates of sales by the mines of primary pgm.

With the exception of the autocatalyst sector, **demand** estimates are net figures, demand in each sector being total purchases by consumers less any sales back to the market. Thus, annual totals represent the amount of primary metal that is acquired by consumers in a particular year.

From 1993, demand numbers for **Europe** include an estimate of net consumption in the former COMECON countries of eastern Europe. From 1996, consumption in China is incorporated into our figures for the **Rest of the World** region. We continue to exclude the CIS from our demand estimates.

Movements in stocks in a given year reflect changes in stocks held by fabricators, dealers, banks and depositories but excluding stocks held by primary refiners and final consumers. A positive figure indicates an increase in stocks; a negative figure indicates a rundown in stocks.

Gross autocatalyst demand is purchases of pgm by the auto industry for manufacture of catalytic converters. **Autocatalyst recovery** is pgm recovered from scrapped catalytic converters and is allocated to the region in which the converter was scrapped.

Investment: small refers to the long-term holding of metal in the form of coins, and bars weighing 10 oz or less. **Investment: large** is in the form of 500 g and 1 kg bars in Japan and includes platinum held on account for subscribers to accumulation plans.

Platinum Supply and Demand

'000 oz	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Supply										
South Africa	2,770	2,750	3,360	3,160	3,370	3,390	3,700	3,680	3,900	**3,920**
Russia	1,100	750	680	1,010	1,280	1,220	900	1,300	540	**1,100**
North America	220	200	220	220	240	240	240	285	270	**285**
Others	70	120	130	140	100	130	120	135	160	**105**
Total Supply	**4,160**	**3,820**	**4,390**	**4,530**	**4,990**	**4,980**	**4,960**	**5,400**	**4,870**	**5,410**
Demand By Application										
Autocatalyst: gross	1,565	1,550	1,685	1,870	1,850	1,880	1,830	1,800	1,610	**1,800**
recovery	(205)	(230)	(255)	(290)	(320)	(350)	(370)	(405)	(425)	**(460)**
Chemical	240	215	180	190	215	230	235	280	320	**270**
Electrical	175	165	165	185	240	275	305	300	380	**470**
Glass	120	80	80	160	225	255	265	220	205	**245**
Investment: small	175	145	125	155	75	110	180	210	90	**45**
large	240	110	180	240	270	130	60	105	90	**(95)**
Jewellery	1,470	1,510	1,615	1,740	1,810	1,990	2,160	2,430	2,880	**2,940**
Petroleum	150	120	105	90	120	185	170	125	115	**110**
Other	140	150	165	190	225	255	295	305	335	**365**
	4,070	**3,815**	**4,045**	**4,530**	**4,710**	**4,960**	**5,130**	**5,370**	**5,600**	**5,690**
Western Sales to China	(20)	0	20	50	130	-	-	-	-	**-**
Total Demand	**4,050**	**3,815**	**4,065**	**4,580**	**4,840**	**4,960**	**5,130**	**5,370**	**5,600**	**5,690**
Movements in Stocks	110	5	325	(50)	150	20	(170)	30	(730)	(280)
	4,160	**3,820**	**4,390**	**4,530**	**4,990**	**4,980**	**4,960**	**5,400**	**4,870**	**5,410**
Demand By Region										
Europe	785	860	895	935	880	840	875	910	985	**1,090**
Japan	2,050	1,870	1,975	2,145	2,215	2,005	1,885	1,795	1,830	**1,515**
North America	815	705	760	940	1,015	1,180	1,250	1,325	1,080	**1,180**
Rest of the World	420	380	415	510	600	935	1,120	1,340	1,705	**1,905**
	4,070	**3,815**	**4,045**	**4,530**	**4,710**	**4,960**	**5,130**	**5,370**	**5,600**	**5,690**
Western Sales to China	(20)	0	20	50	130	-	-	-	-	**-**
Total Demand	**4,050**	**3,815**	**4,065**	**4,580**	**4,840**	**4,960**	**5,130**	**5,370**	**5,600**	**5,690**

Platinum Demand by Application: Regions

'000 oz	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Europe										
Autocatalyst: gross	480	575	610	605	560	515	510	545	560	**630**
recovery	(5)	(5)	(5)	(10)	(15)	(20)	(25)	(30)	(30)	**(40)**
Chemical	55	50	40	50	55	60	70	60	80	**85**
Electrical	30	30	20	25	25	25	45	45	55	**80**
Glass	20	15	15	30	35	40	20	25	25	**25**
Investment: small	40	35	25	45	10	5	5	5	5	**0**
Jewellery	85	85	105	100	120	125	150	160	185	**200**
Petroleum	30	20	25	25	15	15	15	15	15	**10**
Other	50	55	60	65	75	75	85	85	90	**100**
Totals	**785**	**860**	**895**	**935**	**880**	**840**	**875**	**910**	**985**	**1,090**
Japan										
Autocatalyst: gross	380	350	320	290	270	245	255	240	250	**275**
recovery	(35)	(45)	(50)	(45)	(40)	(50)	(50)	(55)	(60)	**(60)**
Chemical	20	20	15	15	20	20	20	20	20	**20**
Electrical	50	50	45	45	45	45	65	55	85	**95**
Glass	35	20	30	80	105	80	85	80	65	**80**
Investment: small	65	40	55	40	35	25	25	25	20	**10**
large	240	110	180	240	270	130	60	105	90	**(95)**
Jewellery	1,260	1,290	1,350	1,450	1,480	1,480	1,390	1,290	1,320	**1,150**
Petroleum	15	10	10	5	5	5	5	5	5	**5**
Other	20	25	20	25	25	25	30	30	35	**35**
Totals	**2,050**	**1,870**	**1,975**	**2,145**	**2,215**	**2,005**	**1,885**	**1,795**	**1,830**	**1,515**
North America										
Autocatalyst: gross	620	525	600	790	820	850	800	775	535	**590**
recovery	(165)	(180)	(200)	(230)	(260)	(275)	(290)	(310)	(320)	**(340)**
Chemical	100	90	75	65	70	80	80	80	95	**90**
Electrical	65	55	65	75	115	130	100	105	125	**150**
Glass	20	15	15	20	25	30	45	20	25	**35**
Investment: small	40	65	40	65	25	75	145	175	60	**35**
Jewellery	20	35	45	55	65	90	160	270	330	**380**
Petroleum	50	35	40	5	40	60	50	40	40	**35**
Other	65	65	80	95	115	140	160	170	190	**205**
Totals	**815**	**705**	**760**	**940**	**1,015**	**1,180**	**1,250**	**1,325**	**1,080**	**1,180**
Rest of the World										
Autocatalyst: gross	85	100	155	185	200	270	265	240	265	**305**
recovery	0	0	0	(5)	(5)	(5)	(5)	(10)	(15)	**(20)**
Chemical	65	55	50	60	70	70	65	120	125	**75**
Electrical	30	30	35	40	55	75	95	95	115	**145**
Glass	45	30	20	30	60	105	115	95	90	**105**
Investment: small	30	5	5	5	5	5	5	5	5	**0**
Jewellery	105	100	115	135	145	295	460	710	1,045	**1,210**
Petroleum	55	55	30	55	60	105	100	65	55	**60**
Other	5	5	5	5	10	15	20	20	20	**25**
Totals	**420**	**380**	**415**	**510**	**600**	**935**	**1,120**	**1,340**	**1,705**	**1,905**

Palladium Supply and Demand

'000 oz	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Supply										
South Africa	1,270	1,260	1,395	1,500	1,600	1,690	1,810	1,820	1,870	**1,960**
Russia	2,150	2,100	2,400	3,300	4,200	5,600	4,800	5,800	5,400	**5,200**
North America	420	450	415	410	470	455	545	660	630	**665**
Others	70	70	70	70	70	95	95	120	160	**95**
Total Supply	**3,910**	**3,880**	**4,280**	**5,280**	**6,340**	**7,840**	**7,250**	**8,400**	**8,060**	**7,920**
Demand By Application										
Autocatalyst: gross	355	490	705	975	1,800	2,360	3,200	4,890	5,880	**5,160**
recovery	(85)	(95)	(100)	(105)	(110)	(145)	(160)	(175)	(195)	**(230)**
Chemical	225	205	190	185	210	240	240	230	240	**260**
Dental	1,165	1,195	1,210	1,265	1,290	1,320	1,350	1,230	1,110	**870**
Electronics	1,855	1,830	2,015	2,230	2,620	2,020	2,550	2,075	1,980	**2,070**
Jewellery	210	205	210	205	200	215	260	235	235	**210**
Other	65	60	35	115	110	140	140	115	110	**60**
Total Demand	**3,790**	**3,890**	**4,265**	**4,870**	**6,120**	**6,150**	**7,580**	**8,600**	**9,360**	**8,400**
Movements in Stocks	120	(10)	15	410	220	1,690	(330)	(200)	(1,300)	**(480)**
	3,910	**3,880**	**4,280**	**5,280**	**6,340**	**7,840**	**7,250**	**8,400**	**8,060**	**7,920**
Demand By Region										
Europe	620	675	680	885	1,340	1,525	1,840	1,985	2,095	**2,335**
Japan	1,800	1,780	1,990	2,200	2,445	1,885	2,350	2,215	2,205	**2,055**
North America	1,095	1,155	1,295	1,430	1,960	2,185	2,675	3,690	4,245	**3,005**
Rest of the World	275	280	300	355	375	555	715	710	815	**1,005**
Total Demand	**3,790**	**3,890**	**4,265**	**4,870**	**6,120**	**6,150**	**7,580**	**8,600**	**9,360**	**8,400**

Palladium Demand by Application: Regions

'000 oz	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Europe										
Autocatalyst: gross	5	40	115	260	650	860	1,100	1,370	1,530	**1,820**
recovery	0	0	0	0	0	(5)	(5)	(5)	(10)	**(15)**
Chemical	70	75	65	60	65	65	70	65	65	**95**
Dental	300	300	265	255	250	255	260	210	180	**110**
Electronics	200	210	210	255	325	300	340	270	255	**260**
Jewellery	35	35	35	30	30	30	50	50	50	**45**
Other	10	15	(10)	25	20	20	25	25	25	**20**
Totals	**620**	**675**	**680**	**885**	**1,340**	**1,525**	**1,840**	**1,985**	**2,095**	**2,335**
Japan										
Autocatalyst: gross	95	85	90	125	145	180	245	480	600	**490**
recovery	(30)	(35)	(30)	(30)	(25)	(30)	(45)	(50)	(55)	**(50)**
Chemical	25	20	20	20	20	20	20	20	20	**20**
Dental	420	450	500	550	580	600	620	590	545	**510**
Electronics	1,160	1,130	1,280	1,400	1,600	990	1,390	1,060	980	**975**
Jewellery	120	120	120	120	115	115	110	105	105	**100**
Other	10	10	10	15	10	10	10	10	10	**10**
Totals	**1,800**	**1,780**	**1,990**	**2,200**	**2,445**	**1,885**	**2,350**	**2,215**	**2,205**	**2,055**
North America										
Autocatalyst: gross	220	320	450	525	950	1,230	1,680	2,820	3,490	**2,430**
recovery	(55)	(60)	(70)	(75)	(85)	(110)	(105)	(115)	(125)	**(155)**
Chemical	80	65	65	60	70	70	70	70	75	**65**
Dental	400	400	400	410	410	410	415	390	350	**230**
Electronics	425	405	420	450	545	490	550	460	395	**415**
Jewellery	5	0	5	5	5	5	10	10	10	**10**
Other	20	25	25	55	65	90	55	55	50	**10**
Totals	**1,095**	**1,155**	**1,295**	**1,430**	**1,960**	**2,185**	**2,675**	**3,690**	**4,245**	**3,005**
Rest of the World										
Autocatalyst: gross	35	45	50	65	55	90	175	220	260	**420**
recovery	0	0	0	0	0	0	(5)	(5)	(5)	**(10)**
Chemical	50	45	40	45	55	85	80	75	80	**80**
Dental	45	45	45	50	50	55	55	40	35	**20**
Electronics	70	85	105	125	150	240	270	285	350	**420**
Jewellery	50	50	50	50	50	65	90	70	70	**55**
Other	25	10	10	20	15	20	50	25	25	**20**
Totals	**275**	**280**	**300**	**355**	**375**	**555**	**715**	**710**	**815**	**1,005**

Rhodium Supply and Demand

'000 oz	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Supply										
South Africa	220	278	278	330	342	359	377	400	410	**434**
Russia	110	80	80	80	80	110	240	110	65	**280**
North America	18	19	17	15	13	5	16	16	18	**20**
Others	0	1	1	1	1	2	3	4	8	**3**
Total Supply	**348**	**378**	**376**	**426**	**436**	**476**	**636**	**530**	**501**	**737**
Demand By Application										
Autocatalyst: gross	301	305	356	379	464	424	418	483	509	**563**
recovery	(16)	(22)	(25)	(34)	(37)	(45)	(49)	(57)	(66)	**(79)**
Chemical	25	18	11	10	13	21	36	31	34	**35**
Electronics	10	7	9	8	8	9	9	6	6	**6**
Glass	12	7	3	14	17	53	43	34	30	**37**
Other	14	13	12	11	9	9	10	10	11	**11**
Total Demand	**346**	**328**	**366**	**388**	**474**	**471**	**467**	**507**	**524**	**573**
Movements in Stocks	2	50	10	38	(38)	5	169	23	(23)	**164**
	348	**378**	**376**	**426**	**436**	**476**	**636**	**530**	**501**	**737**
Demand By Region										
Europe	101	119	127	129	139	154	165	175	180	**196**
Japan	99	63	68	68	59	64	70	75	85	**100**
North America	111	110	127	139	224	170	137	177	165	**159**
Rest of the World	35	36	44	52	52	83	95	80	94	**118**
Total Demand	**346**	**328**	**366**	**388**	**474**	**471**	**467**	**507**	**524**	**573**